



US006481088B1

(12) **United States Patent**  
**Inoue et al.**

(10) Patent No.: **US 6,481,088 B1**  
(45) Date of Patent: **\*Nov. 19, 2002**

(54) **GOLF CLUB MANUFACTURING METHOD**

(75) Inventors: **Akihisa Inoue**, Kawauchijutaku 11-806,  
Kawauchi-Motohasekura 35-banchi,  
Aoba-ku, Sendai-shi, Miyagi (JP);  
**Eiichi Makabe**, Miyagi (JP); **Masahide**  
**Onuki**, Hyogo (JP)

(73) Assignees: **Akihisa Inoue**, Miyagi (JP); **Kabushiki**  
**Kaisha Makabe Giken**, Miyagi (JP);  
**Sumitomo Rubber Industries, Ltd.**,  
Hyogo (JP)

(\*) Notice: This patent issued on a continued pro-  
secution application filed under 37 CFR  
1.53(d), and is subject to the twenty year  
patent term provisions of 35 U.S.C.  
154(a)(2).

Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/112,360**

(22) Filed: **Jul. 9, 1998**

(30) **Foreign Application Priority Data**

Jul. 9, 1997 (JP) ..... 9-184115  
Jun. 4, 1998 (JP) ..... 10-172171

(51) Int. Cl.<sup>7</sup> ..... **B21B 1/46**

(52) U.S. Cl. .... **29/527.5; 164/80; 164/495;**  
**473/324**

(58) Field of Search ..... **29/527.5; 473/324,**  
**473/349, 345, 350, 342, 329; 164/80, 495**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,856,513 A \* 12/1974 Chen et al.  
4,252,262 A \* 2/1981 Igarashi

(List continued on next page.)

**FOREIGN PATENT DOCUMENTS**

JP 8-109419 4/1996

**OTHER PUBLICATIONS**

Tool and Manufacturing Engineers Handbook, 3d Ed., Soci-  
ety of Manufacturing Engineers p. 14-26, 1977.\*

(List continued on next page.)

Primary Examiner—David P. Bryant

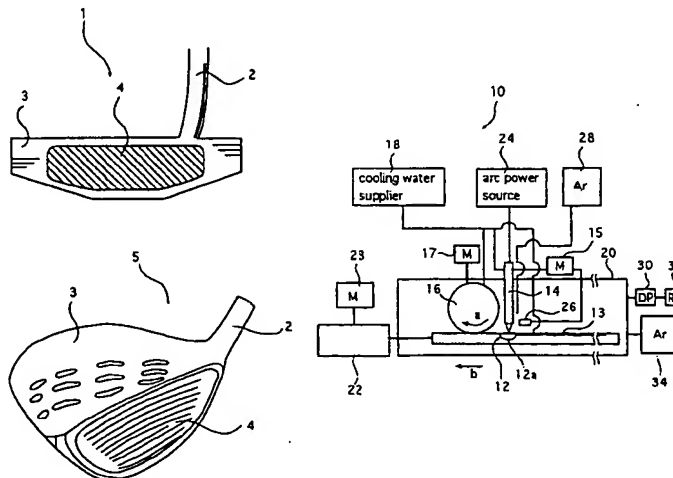
Assistant Examiner—Steven Blount

(74) Attorney, Agent, or Firm—Young & Thompson

(57) **ABSTRACT**

A golf club which has a clubface of desired shape compris-  
ing an alloy metal is provided. The golf club has excellent  
strength properties as well as excellent ball hitting proper-  
ties. The clubface is free from casting defects such as cold  
shuts, and preferably, free from the crystalline phase formed  
from crystal nuclei through nonuniform nucleation since the  
club face is produced in a simple, highly reproducible,  
one-step process by selectively cooling the molten metal at  
a temperature above the melting point at a rate higher than  
the critical cooling rate, and the product comprises a single  
amorphous phase. The metallic glass face used in the golf  
club is produced by filling a metal material in a hearth;  
melting said metal material by using a high-energy heat  
source which is capable of melting said the metal material;  
pressing said the molten metal at a temperature above the  
melting point of said the metal material to deform the molten  
metal into the desired shape by at least one of compressive  
stress and shear stress at a temperature above the melting  
point, while avoiding the surfaces of the molten metal  
cooled to a temperature below the melting point of said the  
metal material from meeting with each other during the  
pressing; and cooling said the molten metal at a cooling rate  
higher than the critical cooling rate of the metal material  
simultaneously with or after said the deformation to produce  
the metallic glass face of desired form.

**15 Claims, 10 Drawing Sheets**





**[11] Patent Number: 6,089,992**

[45] **Date of Patent:** Jul. 18, 2000

5,213,148 5/1993 Masumoto et al. .... 164/222

5,458,334 10/1995 Sheldon et al. .... 473/349

5,620,382	4/1997	Cho et al. ....	473/331
-----------	--------	-----------------	---------

5,779,560	7/1998	Buck et al.	473/342
-----------	--------	-------------	---------

5.896.642	4/1999	Peker et al. ....	29/522.1
-----------	--------	-------------------	----------

[73] Assignees: Sumitomo Rubber Industries, Inc.,  
Kobe; Akihisa Inoue, Sendai, both of  
Japan

8-109419 4/1996 Japan .

9-322953 12/1997 Japan .

10-155944 6/1998 Japan .

*Primary Examiner—Kien T. Nguyen*

**Attorney, Agent, or Firm—**Armstrong, Westerman, Hattori,  
McLeland & Naughton

## [57] ABSTRACT

Aug. 8, 1997 [JP] Japan ..... 9-227363

Sep. 16, 1997 [JP] Japan ..... 9-270423

[51] Int. Cl.<sup>7</sup> ..... A63B 53/04

[52]. U.S. Cl. .... 473/324; 473/342; 473/349

[58] **Field of Search** ..... 473/342, 349.

473/409, 324, 345

of the thickness of the face body, and thickness of the crystal phase layer is arranged to be 0.01 mm to 3.0 mm.

**7 Claims, 28 Drawing Sheets**

4,951,953 8/1990 Kim ..... 473/324

